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# मानक

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IS 6745 (1972): Method for determination of mass of zinc coating on zinc coated iron and steel articles [MTD 24: Corrosion Protection]



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**IS : 6745 - 1972**  
**( Reaffirmed 1994 )**

*Indian Standard*

**METHODS FOR  
DETERMINATION OF MASS OF ZINC  
COATING ON ZINC COATED IRON  
AND STEEL ARTICLES**

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**( Incorporating Amendment No. 1 )**

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**AMENDMENT NO. 2    JANUARY 1987**

**TO**

**IS:6745-1972    METHODS FOR DETERMINATION OF MASS  
OF ZINC COATING ON ZINC COATED IRON AND STEEL  
ARTICLES**

(Page 8, clause 5.2.3, last sentence) - Delete  
and incorporate the following Note thereunder:

'Note - The time required for stripping  
will vary with the coating thickness and  
generally should not exceed 1 minute. The  
time of 1 minute ~~maximum~~ is to ensure that no  
dissolution of iron takes place.'

(SMDC 28)

**AMENDMENT NO. 3 MAY 1989**  
**TO**  
**IS : 6745 - 1972 METHODS FOR DETERMINATION**  
**OF MASS OF ZINC COATING ON ZINC COATED**  
**IRON AND STEEL ARTICLES**

*( Page 5, clause 3.3, line 2 ) — Substitute '50 mm' for '300 mm'.*

( SMDC 28 )

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**AMENDMENT NO. 4    OCTOBER 1996**  
**TO**  
**IS 6745 : 1972    METHODS FOR DETERMINATION OF**  
**MASS OF ZINC COATING ON ZINC COATED IRON AND**  
**STEEL ARTICLES**

( *Page 5, clause 3.2.2* ) — Insert the following note at the end of the clause:

‘NOTE — The wire shall also include the formed wires as per 3.2 of IS 3975 : 1988.’

( *Page 7, clause 5.2.2.1* ) — Substitute the following for the existing:

**‘5.2.2.1 Calculation**

$$M = \frac{M_1 - M_2}{M_2} \times K$$

where

$M$  = mass of zinc coating in  $\text{g/m}^2$  of surface,

$M_1$  = mass of the original test piece in g,

$M_2$  = mass of the stripped test piece in g, and

The value of the constant  $K$  for different sections shall be as under:

<i>Type of Wire</i>	<i>Dimension(s)</i>				<i>Constant</i>
Round	All Sizes				$d \times 1965$
	A	B	C	R	
Formed*	4.0	3.4	0.8	10	2 571
	6.1	5.3	1.4	27.5	4 383

\*For further details of the dimensions refer 3.2 of IS 3975 : 1988.’

( MTD 20 )

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# *Indian Standard*

## METHODS FOR DETERMINATION OF MASS OF ZINC COATING ON ZINC COATED IRON AND STEEL ARTICLES

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(Continued on page 2)

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# *Indian Standard*

## METHODS FOR DETERMINATION OF MASS OF ZINC COATING ON ZINC COATED IRON AND STEEL ARTICLES

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 20 December 1972, after the draft finalized by the Hot-Dip Metallic Coatings Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** For determining the mass of zinc coating, stripping method has been prescribed for galvanized articles, such as sheet and strip, wire, tube, rolled steels, bolts and nuts, castings, forgings etc. Direct method of determining the mass of zinc coating by weighing the articles before and after galvanizing and subtracting the first mass from the second and dividing the result by surface area has not been included in the standard as it gives a slightly lower results. Volumetric method has been included for determining the mass of zinc coating on steel wire as this method gives reasonably accurate results for routine testing.

**0.3** The test methods have been based on the test procedures generally followed in the country in this field. Assistance has also been derived from the following publications:

BS 443 : 1969 Specification for galvanized coatings on wire. British Standards Institution. UK.

ASTM Part 3 1970 Steel sheet, strip, bar, rod, wire, metallic coated products. American Society for Testing and Materials. USA.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the results of a test or analysis, shall be rounded off in accordance with IS: 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard covers the procedures for determination of mass of coating on zinc coated sheet, wire and other iron and steel articles.

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\*Rules for rounding off numerical values ( revised ).

## 2. QUALITY OF REAGENTS

**2.1** Unless otherwise specified, pure chemicals shall be employed in tests and distilled water ( *see* IS : 1070-1960\* ) shall be used when the use of water as a reagent is intended.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

## 3. SAMPLING

**3.0** Sampling of the material shall be done in accordance with the relevant material specification. This clause relates only to the preparation of test pieces from the samples thus taken.

### 3.1 Galvanized Sheet

**3.1.1** The test piece shall be taken by one of the following methods subject to purchaser's requirements:

- a) *Triple Spot Test* — Three test pieces either square or circular to size 50×50 mm or 50 mm dia shall be taken one from the centre and two from the opposite ends of the diagonal line, at least 100 mm away from the top or the bottom and at least 50 mm away from the side. For sheets galvanized by the continuous method, three test pieces shall be taken at the end part of the coil, one from the centre and two from the location at least 50 mm away from each side.
- b) *Single Spot Test* — In this test, one test piece out of the three test pieces taken by the same method as for the triple spot test, showing a minimum coating mass, shall be selected, or the test piece shall be taken from an arbitrary place within at least 100 mm away from the top or bottom and at least 50 mm away from the side.

**3.1.2** When it is not possible to obtain a test piece of measurable area, such as described in 3.1.1, from corrugated sheet, the following formula may be used to calculate the mass of coating:

$$M = \frac{M_1 - M_2}{M_2} \times t \times 7\,860$$

where

$M$  = mass of zinc coating in g/m<sup>2</sup> of sheet,

$M_1$  = mass in g of galvanized test piece,

$M_2$  = mass in g of stripped test piece, and

$t$  = thickness of stripped sheet in mm.

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\*Specification for water, distilled quality ( *revised* ).

### 3.2 Galvanized Wire

**3.2.1** The sample length of the wire shall be cut from one or both ends of the coil under test. Portions of wire which are obviously damaged shall not be used for sample. In the case of stranded or armoured wire, or wire which has undergone any other similar process, care should be taken to avoid damage in preparing the sample. If desired by the purchaser, sample may be cut from each selected coil or reel of strand or cable or from any portion of such wires.

**3.2.2** The test piece of galvanized wire may be of any length over 300 mm but preferably 600 mm. Where continuous length is not available, shorter test piece totalling over 300 mm but preferably 600 mm shall be used. Since the specific gravity of steel is known, it is not necessary to use a specific length.

**3.3 Galvanized Tube** — A tubular test piece of 100 mm in length shall be taken from each end of product. Before cutting the test piece, 300 mm in length from both ends of the product shall be discarded.

**3.4 Galvanized Articles Other than Sheet, Wire and Tube** — These include the following:

- a) *Rolled Steel* — plates, fabricated structures, bars, flats, etc.
- b) *Bolts and Nuts* — bolts and threaded articles including nuts and washers.
- c) *Castings and Forging* — cast steels, cast iron and malleable cast iron products, pipe fittings, structural shapes, assembled products, etc.

**3.4.1 Galvanized Rolled Steel** — The test piece shall be cut from the galvanized product by one of the following methods, subject to the purchaser's requirements:

- a) The test piece shall be of the size and the coated area of 100 cm<sup>2</sup>, and
- b) The test piece may be taken from the original material cut to a suitable size and galvanized in the same manner as the product.
  - 1) *Triple Spot Test* — For steel plate, three test pieces, as in the case of steel sheet, shall be taken, one from the centre of the plate and the other two from opposite locations of the diagonal line, at least 100 mm away from top or bottom and at least 50 mm away from the side.

For steel shapes, three test pieces shall be taken from centre and both ends, eliminating 50 mm from both ends.

For steel bars and flats, three test pieces shall be taken from centre and both ends, eliminating 50 mm from both ends.

- 2) *Single Spot Test* — One test piece presenting a minimum zinc coating out of the test pieces taken for triple spot test or one taken arbitrary from place other than close to both ends shall be selected.

**3.5 Galvanized Bolts and Nuts** — A product as manufactured shall be used as the test piece but the determination shall be made on the portion of the article that does not include any thread. When the product is too large or inconvenient in handling, a suitable piece shall be cut off from the product to make a test piece.

**3.6 Castings and Forgings** — Actual product may be used as a test piece or the test piece may be taken by one of the following methods with the consent of purchaser:

- a) Should the material happen to be too large, too heavy or inconvenient in handling, a suitable piece shall be cut off from the original product to make a test piece.
- b) Alternatively, shorter piece of the same section and of the same steel composition not less than 90 cm long may be used as test piece, after it has been galvanized in the same bath along with the material it represents. This method of preparing test piece is also applicable in case of articles whose surface area may be difficult to determine.

## 4. CLEANING OF TEST PIECE

**4.1** The test pieces shall be washed with solvent naphtha, trichloroethylene or any other suitable organic solvent, then with alcohol and finally dried thoroughly.

## 5. STRIPPING METHOD

### 5.1 Stripping Solution

**5.1.1** Dissolve 20 g of antimony trioxide ( $\text{Sb}_2\text{O}_3$ ) or 32 g of antimony trichloride ( $\text{SbCl}_3$ ) in 1 000 ml of concentrated hydrochloric acid (sp gr 1.16).

**5.1.2** Immediately before test, prepare the stripping solution by adding 5 ml of the solution prepared under 5.1.1 to 100 ml of concentrated hydrochloric acid (sp gr 1.16). Mix well.

### 5.2 Procedure

**5.2.1 Galvanized Sheet** — For triple spot test, weigh three test pieces together to 0.01 g. Immerse one test piece at a time in the test solution. When the evolution of hydrogen ceases or a few bubbles are being evolved, the test pieces shall be taken out, washed in water, wiped off well with

clean soft cotton cloth, fully dried and weighed again. Calculate the mass of zinc coating/unit area of the surface by dividing the difference in mass in grams before and after stripping by the area of the test specimen in square metres. When it is not possible to obtain a test piece of measurable area, use formula given in 3.1.2 to calculate the mass.

### 5.2.1.1 Calculation

$$M = \frac{M_1 - M_2}{A} \times 10^6$$

where

$M$  = mass of zinc coating in g/m<sup>2</sup> of surface,

$M_1$  = original mass in g of the test piece,

$M_2$  = mass in g of the stripped test piece, and

$A$  = coated area of the original test piece in mm<sup>2</sup>.

NOTE 1 — In case of triple spot test, the average mass of zinc coating as obtained from three test samples shall be reported.

NOTE 2 — During the test, the temperature of the test solution shall not exceed 38°C.

NOTE 3 — The same solution may be repeatedly used and without further addition of antimony chloride solution, until the time for stripping becomes inconveniently long.

**5.2.2 Galvanized Wire** — Weigh the clean test piece to 0.01 g. When the test piece is too long for the container, it shall be either bent or coiled to permit complete immersion in the test solution. When the evolution of hydrogen ceases or a few bubbles are being evolved, take out the test piece, wash in running water, wipe off well with clean soft cotton cloth, fully dry and weigh again to within the nearest 0.01 g. Then measure the diameter to 0.01 mm at two places at right angles to each other of the same location to obtain the average value. Calculate the mass of coating in g/m<sup>2</sup> as in 5.2.2.1.

NOTE 1 — The time required for stripping will vary with the coating thickness but should not exceed one minute. The number of specimens immersed at any one time shall not exceed three per 100 ml of the solution.

NOTE 2 — The same solution may be repeatedly used and without further addition of antimony chloride solution, until the time for stripping becomes inconveniently long.

### 5.2.2.1 Calculation

$$M = \frac{M_1 - M_2}{M_2} \times d \times 1965$$

where

$M$  = mass of zinc coating in g/m<sup>2</sup> of surface,

$M_1$  = original mass in g of the test piece,

$M_2$  = mass in g of the stripped test piece, and

$d$  = diameter of the stripped test piece in mm.

**5.2.3 Articles Other than Sheet and Wire** — Weigh the cleaned test piece whose mass is less than 200 g nearest to 0.01 g, for test piece whose mass is between 300 to 1 000 g, weigh to the nearest 0.1 g and for masses over 1 000 g, the accuracy of weighing shall be nearest to 0.5 g. After weighing immerse each test piece singly in test solution prepared in 5.1.1 and allow to remain there until the violent evolution of hydrogen ceases, and only a few bubbles are being evolved. This requires about 15 to 30 seconds except in the case of sherardized coatings which require somewhat longer time.

**5.2.3.1** For test piece of uniform thickness of base metal, such as a piece of plate or pipe, determine the average thickness of the test piece to the nearest 0.25 mm and calculate the mass of zinc coating as in 5.3.

### 5.3 Calculation

$$M = \frac{M_1 - M_2}{M_2} \times t \times 3\,930$$

where

- $M$  = mass of zinc coating in  $\text{g/m}^2$  of surface,
- $M_1$  = original mass in g of test piece,
- $M_2$  = mass in g of stripped test piece, and
- $t$  = thickness of the stripped test piece in mm.

## 6. DETERMINATION OF MASS OF COATING ON WIRE (BELOW 5 mm IN NOMINAL DIAMETER) BY VOLUMETRIC METHOD

**6.1 Outline of the Method** — The volumetric method of determining the mass of coating depends on the fact that a metal dissolved in acid always releases a quantity of hydrogen in strict proportion to the amount of metal dissolved.

**6.2 Reagents** — same as in 5.1.

**6.3 Apparatus** — The apparatus should consist of a 100-ml glass burette fitted with a stopcock at the top and the bottom and connected at the bottom with a rubber tube to a reservoir. The apparatus set up for the commencement of a test is shown in Fig. 1.

**6.4 Preparation of Test Piece** — Cut accurately a test piece of required length from a sample of wire. The most suitable length of the test piece

depends on the size of the burette, diameter of wire and expected mass of zinc coating. The lengths given below will be found convenient.

<i>Nominal Diameter of Galvanized Wire</i>	<i>Length of Test Piece</i>
mm	mm
Above 0.4 to 1.00	300
Above 1.00 to 1.50	150
Above 1.50 to 3.00	100
Above 3.00	50

**6.5 Cleaning of Test Piece** — The test piece may be cleaned as described in 4.1.

## 6.6 Procedure

**6.6.1** Pour the acid reagent into the reservoir so that it completely fills the burette leaving a small portion in the reservoir when in the elevated position.

**6.6.2** To carry out a test, adjust the height of the reservoir *C* so that the acid reagent just fills the burette up to the stopcock *A* with the bottom stopcock *B* closed. Drop the sample of the specified length into the burette and close the upper stopcock *A* immediately.

**6.6.3** The zinc coating rapidly dissolves and liberates hydrogen and the test is continued until evolution of hydrogen, but for a few fine bubbles, has ceased. Lift the reservoir *C* from its supporting ring and place alongside the burette until the levels of the acid reagent in the burette and the reservoir are equal as shown in Fig. 2, when the volume of hydrogen is read off on the burette scale.

**6.6.4** When the test is concluded, open the upper stopcock *A* and draw all acid reagent from the burette by lowering the reservoir *C* to a position below lower stopcock *B*. Open lower stopcock *B* to eject the test piece.

**6.6.5** This method is usually limited to wires of maximum diameter 5 mm, as with larger diameters, problems of test piece preparation and damage to the glass burette may be introduced. However, where long test pieces are necessary, rapid entry into the burette may be difficult and it may be more convenient to drop the short piece simultaneously through the stopcock.

**6.6.6** Wash the stripped wire, wipe it dry and measure the diameter to 0.01 mm at right angle to each other of the same location to obtain the average value.



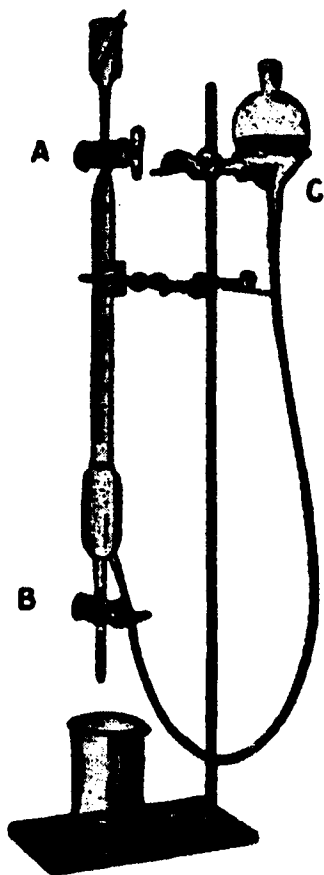


FIG. 1 APPARATUS FOR VOLUMETRIC METHOD — READY FOR TEST

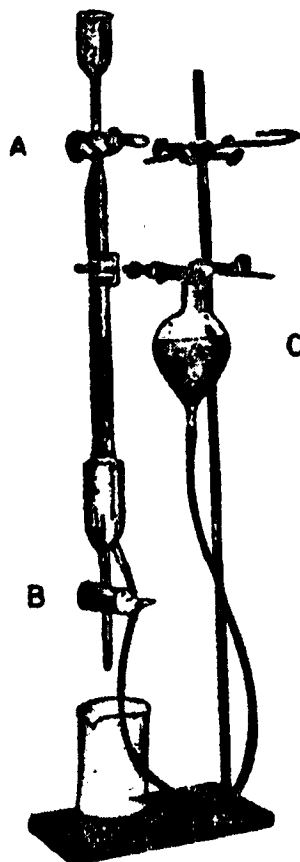


FIG. 2 APPARATUS FOR VOLUMETRIC METHOD — READING TAKEN

## 6.7 Calculation

$$\text{Mass of coating in g/m}^2 = \frac{v \times f}{d \times l}$$

where

$v$  = \*corrected volume of hydrogen in ml that would be displaced at 0°C and 760 mm mercury pressure,

$f$  = 929. It is a factor obtained on the basis that 343 ml of hydrogen are liberated at 0°C and 760 mm mercury pressure by one gram of zinc,

$d$  = the diameter in mm of stripped wire, and

$l$  = the length of the test piece in mm.

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\*Corrected volume should be calculated by using the ' gas equation '.

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**AMENDMENT NO. 5 NOVEMBER 2010**  
**TO**  
**IS 6745 : 1972 METHODS FOR DETERMINATION**  
**OF MASS OF ZINC COATING ON ZINC COATED**  
**IRON AND STEEL ARTICLES**

(*Page 7, Note 1 under clause 5.2.2*) — Substitute the following for the existing note:

‘NOTE 1 — The time required for stripping will vary with the coating thickness but normally it does not exceed 1 minute. The number of specimens immersed at any one time shall not exceed three per 100 ml of the solution.’

(MTD 24)

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Reprography Unit, BIS, New Delhi, India